

The *ART* of NUMBRING

BY

SPEAKING-RODS:

Vulgarly termed

Nepeirs Bones.

By which

3

The most difficult Parts of

ARITHMETICK,

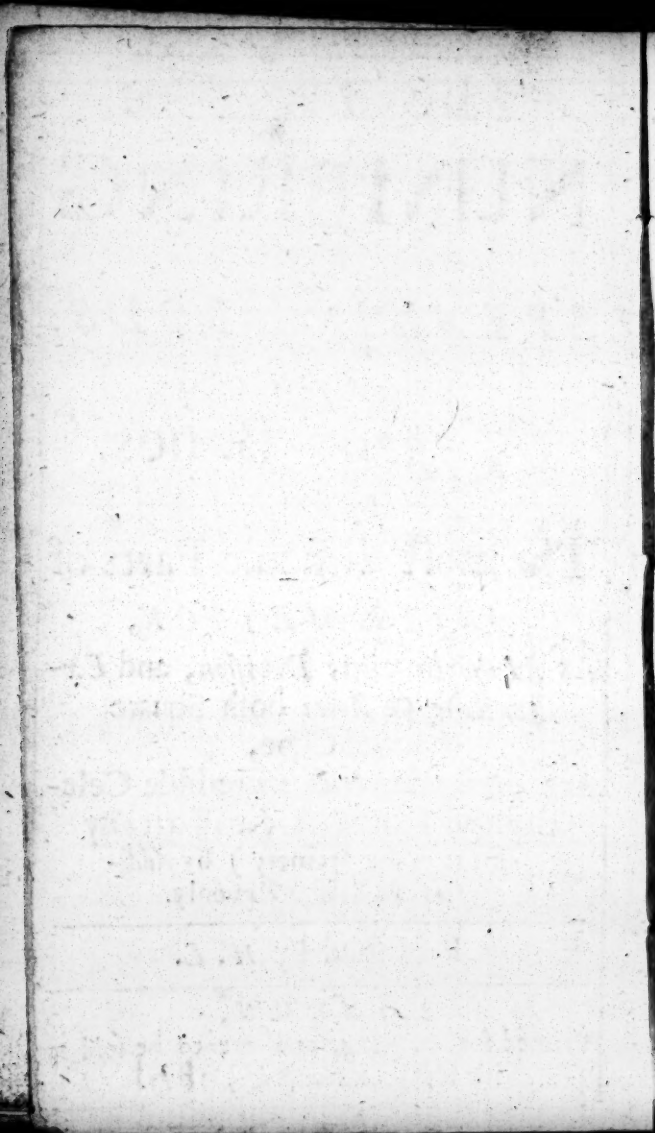
*As Multiplication, Division, and Ex-
tracting of Roots both Square
and Cube,*

Are performed with incredible Cele-
rity and Exactness (without any
charge to the Memory) by *Addi-
tion and Substraction* only.

Published by *W. L.*

L O N D O N;

Printed for *W. Hayes*, and are to be sold at
his House in *Moorfields*, 1667.





THE
ARGUMENT
TO THE
READER.

T*He Right Honourable
John Lord Nepeir,
Baron of Merchiston in
Scotland ; In the Compo-
sure of those ever to be ad-
mired Tables of his Inven-
tion called Logarithms,*

A 3

finding

finding his Calculations so laborious in long and tedious Multiplications, Divisions, and Extracting of Roots, that his Invention to him must needs render it self very unpleasant, had he not known that the Labour when finished will crown both Him and his Work. He advised with divers Learned men studious in the Sciences Mathematical, and to them (and amongst them) especially to Mr. Henry Briggs, who (by a Learned
ed.

ed and able Divine) was
stiled (and not without
due respect) our English
Archimedes , to him , I
say , this honourable Lord
imparted his Invention ,
who joyning issue with him
in this Herculean Labour ,
brought them to that per-
fection to which they are
now (to the admiration
of all Europe) arrived.

In the tedious calcula-
tion of these Numbers , the
Author finding his Work to
go on but very slowly , at

length studying out for some
help by Art to assist him in
this his Noble Enterprise,
thinking upon several helps;
at last (by the blessing of
God) he hapned to finde
out this which I here in-
tend to describe and shew the
use of, with some Additions
and variation, from what
he hath himself done in his
Treatise in Latine, Pub-
lished and Printed at Edin-
burgh in Scotland, in
Anno 1617, Entituled
Rabdologiæ seu Nume-
rationis.

rationis per Virgulas. The
uses whereof I shall in the
following Tractate endea-
vour to render so plain and
easie, that he that can but
Add and Substract shall be
made able in a days time and
less to Multiply and Di-
vide any great Numbers,
nay, and to Extract both the
Square and Cube Roots.

I have begun this Trea-
tise with the Fabrick and
Inscription of these Rods
according to the Authors
Description, which being

not so convenient either for Portability or Practice, as some others which I have seen and used, I have described them (I think) in the best manner they possible can be contrived.

For their Use, I am sure I have done more than hitherto I have seen done, and (if I mistake not) to as good and effectual purpose. I do not publish it as a Novelty, neither do I attribute much in it to myself, besides the Method, for had I
not

not been desired, I should
hardly have thought upon
it; however it being done,
Accept it and Use it, till I
direct something else to thee
which may be more accepta-
ble, till when, I bid thee
heartily

Farewel.

CHAP.

Fig: 1.

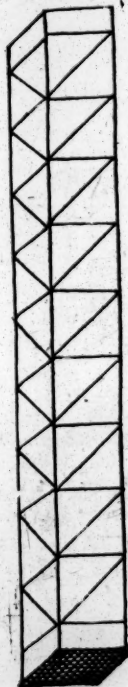


Fig: 2.

3	4		
3	4	5	5
6	8	8	0
9	1	7	5
1	1	9	0
1	5	1	0
1	8	4	7
2	1	8	1
2	4	3	2
2	7	3	6
		9	5

Fig: 3.

0	1	2	3	4
0	2	4	6	8
0	3	6	9	1
0	4	8	1	2
0	5	1	0	1
0	6	1	2	1
0	7	1	4	2
0	8	1	6	2
0	9	1	8	2
1	2	5	7	5
2	4	9	8	7
3	6	9	5	7
4	8	5	7	5
5	9	5	7	5
6	8	5	7	5
7	9	5	7	5
8	9	5	7	5
9	5	7	5	5
6	8	7	9	5

Place this Figure at the
begining of the Book

Fig: 4.

1	3	4	9	6
2	6	8	1	8
3	9	1	2	7
4	1	2	1	3
5	1	5	2	0
6	1	8	2	4
7	2	1	2	8
8	2	4	3	2
9	2	7	3	6

The Tabulat with Rods on it

Square.

0	1	2	1
0	4	4	2
0	9	6	3
1	6	8	4
2	5	10	5
3	6	12	6
4	9	14	7
6	4	16	8
8	1	18	9
6	18	6	7
8	7	9	1
4	6	7	5
9	9	9	1
5	5	5	1
7	9	1	9
6	6	4	0
7	7	8	0
1	1	1	0

Cube.

3.

2	3	4
4	6	8
6	9	12
8	12	16
10	15	20
12	18	24
14	21	28
16	24	32
18	27	36
20	30	40
22	33	44
24	36	48
26	39	52
28	42	56
30	45	60
32	48	64
34	51	68
36	54	72
38	57	76
40	60	80
42	63	84
44	66	88
46	69	92
48	72	96
50	75	100
52	78	104
54	81	108
56	84	112
58	87	116
60	90	120
62	93	124
64	96	128
66	99	132
68	102	136
70	105	140
72	108	144
74	111	148
76	114	152
78	117	156
80	120	160
82	123	164
84	126	168
86	129	172
88	132	176
90	135	180
92	138	184
94	141	188
96	144	192
98	147	196
100	150	200

Place this Figure at the
beginning of the Book

Fig: 4.

1	3	4	9	6	3 4 9 6
2	6	8	1	2	6 9 9 2
3	9	1	2	7	1 0 4 8 8
4	1	2	1	6	1 3 9 8 4
5	1	5	2	0	1 7 4 8 0
6	1	8	2	4	2 0 9 7 6
7	2	1	2	8	2 4 4 7 2
8	2	4	3	2	2 7 9 6 8
9	2	7	3	6	3 1 4 6 4

The Tabulat with Rods on it

Square.

0	1	2	1
0	4	4	2
0	9	6	3
1	6	8	4
2	5	10	5
3	6	12	6
4	9	14	7
6	4	16	8
8	1	18	9
6	18	6	4
8	9	1	5
4	6	7	8
9	9	1	2
5	5	5	1
7	9	1	9
6	6	4	0
7	7	8	0
1	1	1	0

Cube.

(1)



CHAP. I.

Concerning the
Fabrick and Inscription

Of these

R O D S.

IN the foregoing Argument I told you, That the Author and Inventer of this kind of Instrument, of which I intend to shew the Use, called it *RABDOLOGIA*, and the Word he thus defines:

RABDOLOGIA est Ars Computandi per Virgulas numeratrices. That is, *RABDOLOGIE* is the Art of Counting by Numbering Rods.

B

I. Of

I. *Of the Fabrick of these Rods,
according to the Inventors De-
scription of them.*

These Rods may be made either of *Silver, Brass, Box, Ebony, or Ivory*, of which last substance I suppose they were at first made, for that they are (for the most part) by all that know or use them, called *NEPAIRS-BONES*.

But let the matter of which they are made be what it will, their form (according to this description) is exactly a square Parallelepipedon, the length being about three Inches, and the breadth of them about One tenth part of the length. But the length of these Rods are not confined to three Inches, but let the length be what it will, the breadth must be a tenth part thereof, but that may be accounted a competent breadth that
is

is capable of receiving of two numerical Figures, for there is never upon one Rod required more to be set on the breadth thereof.

The breadth of these Rods being exactly One tenth part of the length thereof, when 10 of these are laid together they do exactly make a Geometrical square, and if 20 of them be tabulated or laid together, they will make a right-angled Parallelogram, whose length is double to its breadth. If 30 be tabulated, the Figure will be still a Parallelogram, whose length will be three times the breadth, and so if 40, four times the length -- 65, *ſic* 650.

The Rods being thus prepared of exact length and breadth, let each of them be divided into 10 equal parts, with this *Proviso*, that Nine of the Ten parts stand in the middle of each Rod, and the other tenth part must be divided into two parts, half

whereof must be set at the one end, and the other half at the other end of the same Rod. Then from side to side draw right Lines from division to division, so is your Rod divided into Squares on every side thereof. Lastly, from corner to corner of every of these Squares draw a Diagonal Line, and that will divide every Square into two Triangles. The Rods being thus prepared and lined first into Squares, and then into Triangles, they are then fit to be numbered.

The Figure I. at the beginning of the Book shews the Form of one of these Rods lined as it ought to be.

CHAP.

CHAP. II.

*How these Rods are to be Num-
bred.*

IN the two half Squares which are at the ends of each Rod on every side, there are set one single Figure, on each side of every Rod one, in the division at the end thereof, so every Rod containing four sides, Ten Rods will contain 40 sides, and so consequently will have 40 single Figures at the ends of every of them; that is, there will be upon the ten Rods amongst them four Figures of each kinde, that is, four Ones, *IIII*. four twos, *2222*. four threes, *3333*. four fours, *4444*. four fives, *5555*. four sixes, *6666*. four sevens, *7777*. four eights, *8888*. four nines, *9999*. four Cyphers, *0000*.

B 3

And

And here it is to be noted, That what Figure soever it be that standeth at the top of the Rod alone, the Figure that standeth alone on the other side of the same Rod, maketh that figure up the number 9. As for example; If 1 stand on one side, 8 will stand on the other side, so 2 and 7 be : As in this Table, where,

If	1		8	
	2		7	
	3	stands alone	6	standeth on
	4	at the top of	5	the other
	5	any side of	4	side of the
	6	any of the	3	same Rod.
	7	Rods, then	2	
	8		1	
	9		9	
	0			

This also is to be observed in the figuring of every Rod, that what figure soever

soever standeth alone at the top or superior part of the Rod, the figure or figures that stand in the two Triangles next underneath it, is double to the figure which standeth at the top. And the figures which stand in the next two Triangles below, that is three times as much as the figure above. And that in the fourth place, or Triangles, is four times as much as the figure above 650, till you come to the lowest Triangles in that Rod, and then the figure or figures that stand in those Triangles are nine times as much as the figure which standeth at the top of the Rod.

So if a Rod have 4 at the top thereof, in the two Triangles which are just and next under it, hath only 4 in them, which is equal to 4; in the next two Triangles below, there is 8, which is double to 4; in the two Triangles below them, is 1 and 2, which together make 12, which is

B 4. three

three times as much as the 4 at the top; the next Triangles have in them 16, which is four times as much; the next 20, which is five times as much; the sixth hath 24, which is six times as much. The next Triangles have in them 28, which is seven times 4; the next hath 32, which is eight times as much: And the last Triangles at the bottom they have 36 in them, which is nine times as much. All which is visible by the Figure 2 at the beginning of the Book.

And is evident enough by this little Table following, which is the Table of Multiplication, commonly called *Pythagoras* his Table.

Figures at the top of each Rod.

The figures in the																			
First	0	1	1	2	1	3	1	4	1	5	1	6	1	7	1	8	1	9	
Second	0	1	2	1	4	1	6	1	8	1	10	1	12	1	14	1	16	1	18
Third	0	1	3	1	6	1	9	1	12	1	15	1	18	1	21	1	24	1	27
Fourth	0	1	4	1	8	1	12	1	16	1	20	1	24	1	28	1	32	1	36
Fifth	0	1	5	1	10	1	15	1	20	1	25	1	30	1	35	1	40	1	45
Sixth	0	1	6	1	12	1	18	1	24	1	30	1	36	1	42	1	48	1	54
Seventh	0	1	7	1	14	1	21	1	28	1	35	1	42	1	49	1	56	1	63
Eighth	0	1	8	1	16	1	24	1	32	1	40	1	48	1	56	1	64	1	72
Ninth.	0	1	9	1	18	1	27	1	36	1	45	1	54	1	63	1	72	1	81

1	2	3	4	5	6	7	8	9
---	---	---	---	---	---	---	---	---

Square which are

Times as much as the Figure at the top.

Thus have you the *Falrick*, *Inscription* and *Numtering* of these Rods, according to the Inventors contrivance of them: He makes mention of Ten of them, and hath in his Book set the figure of the said Ten, of one of which Ten I have given you a Scheme at the beginning of the Book, which is Figure 2. I will now proceed to give you the description of these Rods in another more commodious form,

CHAP. III.

A Description of these Rods according to their best and latest Contrivance.

THe Description which I shall here give of these Rods, varies not at all from that before delivered in

in the matter of which they are made, for these may be made either in Silver, Brass, Wood, Ivory, &c. Neither do they differ in their dividing, nor yet in their numbering: Only whereas my Lord *Nepair* maketh them square, each Rod to contain four sides, these are made flat, consisting each Rod but of two sides, and contain in length about
and in breadth
and in thickness

One set of these Rods consisteth of five pieces, and therefore hath but ten Faces or sides, whereas those of the Lord *Nepairs* consisted of 40 Plains or sides.

Upon one of these five pieces (a Figure whereof is at the beginning of the Book, noted with Figure 3) you have a Cypher at the head of the first piece, and 9 at the bottom thereof. Upon the second of them you have 1 at the head, and 8 at the bottom:
upon

upon the third you have 2 at the head and 7 at the bottom ; upon the fourth 3 at top and 6 at bottom ; and upon the fifth you have 4 at the top, and 5 at the bottom. Every of the two Figures at the top and bottom together make 9 ; as 0 and 9 is 9, 1 and 8, 2 and 7, 3 and 6, 4 and 5. And here observe, that the Figures 9 8 7 6 5 ; which stand at the bottom of the Scheme stand with their heels upwards, in this manner, 6 8 L 9 5, and so do all the other figures under them, till you come to the double Line which is in the middle of the Scheme, noted with *A* and *B*, at which Line if the Scheme were cut into two pieces, and folded or pasted on the back-side of the other half, so that the 9 at the bottom were placed upon the Cypher at the top, and so 8 upon 1, 7 upon 2, 6 upon 3, and 5 upon 4, and then the Scheme cut again into five little slippets by the down-right Lines ;

Lines ; these five slippets would exactly represent one set of these Rods, for upon one side of one of these pieces; you should have a Cypher upon one side, and 9 on the other ; Upon the next 1 and 8, upon another 2 and 7, on another 3 and 6, and on the other 5 and 4 ; both the Figures on either side making 9, as before was described.

These five slippets do now contain the whole Table of *Pythagoras* before mentioned, but for so few are not of sufficient use, neither are the Ten before mentioned of the Lord *Nepair's* order ; for there can be but four Figures of one kind, which in all cases is not sufficient.

Therefore as these Rods are made now a days, they do commonly make six sets of them, that is, 30 pieces; which contain 60 faces, and these will be of good use, and there will seldom be found a want, which in those
of

of the Inventors there will often be, except you have a great quantity, which will be far more cumbersome than these here described, for there is required as much Metal or Wood in one of his, as in four of these, and then for his Four sides we have here Eight.

*Concerning a Case for these
Rods.*

For the orderly keeping and ready finding of these Rods, I have often (for my self and others) had a Box made of Walnut-tree or Pear-tree, with five partitions in it, each partition to hold five or six sets of these Rods, or more if more Rods were required. Every of these partitions being figured on the side thereof next the Eye, with such figures as the Rods in such a partition had figures at the top, so that the party that was to use

use them, could take them as readily out of his partition, as a Printer can take his Letters out of his respective Boxes to make any Word.

In this Box there is also convenient room made for one other Rod, double in breadth to these here described, but of the same length and thickness; upon the one side whereof there is a Table or Plate useful in the Extracting of the Square Root, and on the other side another for the Extracting of the Cube Root, the Figure whereof is at the beginning of the Book, noted with Figure

But I shall forbear to say any thing of them, till I come to shew you how to Extract the Square and Cube Roots by the help of them and the Rods.

Of a Board with a Frame, upon which to lay your Rods, when any Operation is to be wrought by them, known by the name of a
TABULAT.

In the using of these Rods, care is to be had first of the orderly laying of them, and then secondly, for the keeping of them in that position till your work be ended. For the effecting whereof, both neatly and certainly, there is a little Table or Frame contrived, containing in breadth $\frac{1}{2}$ of an Inch more than the length of the Rods, and in length at pleasure, but it may well be about once and a half the length of the breadth.

It ought to be made of a thin piece of Pear or Walnut-tree, or of such matter as your Box or Case is made of, and it may very commodiously be contrived to be put into the
 Box

Box as I ever had them made to do, for that I found it inconvenient to carry loose.

Upon the Superficies of this Board, close to one of the edges thereof, must be glewed, or otherwise fastned with Pins, a small piece of the same matter and also of the same length, breadth, and thickness of one of your Rods, which must be divided into 9 equal parts, and Lines drawn cross the piece, so will there be 9 Squares, in which you must Grave or stamp the nine Digits, beginning with 1 at the top, and so descending by 2 3 4 to 9 at the bottom thereof: And it were necessary that these Figures (as also those which are at the head of every of your Rods) were graven or stamped of something a bigger Figure then the other figures of your Rods are.

Under the end of this ledge beginning at the Figure, and so continuing

ning the whole length of the Board, must another ledge of the same matter and thickness as the other, be glewed or pinned, and then is your *Tabulat* finished. A Figure whereof you have at the beginning of the Book, noted with Figure 4, it is called a *Tabulat*, for that when the Rods are laid thereon, for any Operation to be wrought by them, we usually say, the Rods are *Tabulated*.

Being thus prepared with Rods and *Tabulat*, you are ready for the work intended by them, and for which chiefly they were invented.

Thus much for the Fabrick, Inscription, and Numbering of these Rods; let us now come to shew the Uses of them.

CHAP. IV.

To what use these Rods generally serve.

THe chief Uses to which these small Rods serve unto, I in part intimated at the beginning, to which effect I shall repeat it again—for by them all manner of Multiplications and Divisions, as also of the Extraction of both the Roots either Square or Cube, are so facilly and expeditiously performed, and that by the help of Addition and Substraction only, that it is (as I may well say) inconceivable, for here is no charge at all required of the Memory, and you shall assuredly take your Quotient Figure in Division always certain; neither too great nor too little, an inconvenience so prejudicial, that I leave it to the censure of such as have

have found it, to their great loss of time, and other vexation which it hath put them to. But ceasing to say more of their properties, I will now come to shew their Use.

CHAP. V.

How to apply or lay down any Numbers by the Rods.

PROP. I.

Any Number being given, how to Tabulate or lay down the same by the Rods.

LEt it be required to Tabulate or lay down this Number 3 4 9 6.

First, From among your Sets of Rods, (or out of your Case) take four of them, of which let one of them have the Figure 3 at the top thereof, and

and lay it upon your Tabulat close to the edge thereof, ; then,

Secondly, Take another Rod from your Case, which hath the Figure 4 at the top of it, and lay that also upon your Tabulat close by the side of the other.

Thirdly, Take another Rod which hath the Figure 9 at the top of it, and lay that upon your Tabulat close by the other two.

And lastly, take a fourth Rod, having the figure 6 at the head thereof, and lay that also upon your Tabulat close by the rest.

These four Rods thus taken, and laid upon the Tabulat, you shall see in the uppermost Row (which standeth against the Figure 1 on the side of your Tabulat) these four Figures, 3 4 9 6, that is 3496, equal to your given Number. In the second Row (against the figure 2 of your Tabulat) you shall finde the double thereof.

of. In the third (against the figure 3) you shall finde the triple thereof. In the fourth the Quadruple thereof. In the fifth the Quintuple; and so on the ninth and last, in which you shall finde the Noncuple of the Number given.

PROP. II.

How these Rods will appear when Tabulated, and being Tabulated, how to read the Multiplication of that Number so Tabulated, by any of the Nine Digits.

The Four Rods being Tabulated according to the Precepts delivered in the preceding Proposition, they will appear exactly as they are represented in Figure 4 at the beginning of the Book, which Figure lively represents the four Rods lying upon the Tabular, which minde well, for upon the true tabulating, and right reading

reading of the Rods so tabulated, depends the whole Work.

The Rods thus Tabulated, and as you see them in the *Figure 4*, do to the eye appear in the form of a Glass-window, every Pane thereof representing a Rhomboyades or Diamond form: In the reading of the Figures which are in these several Rhomboyades or Diamond form, observe these few Directions following, which will fully illustrate the whole business intended, and therefore especially to be minded.

Note,

I. *That the Figures upon the Rods are to be read beginning at the right hand and reading towards the left; which is contrary to our common course of reading and writing, which is from the left hand towards the right.*

II. *That*

II. That in every Rhomboyades or Diamond, there are either One Figure, or Two Figures, but never more then Two.

III. If there be but one Figure in a Rhombus, then that Figure is the Figure to be set down alone (be it either a Figure or a Cypher) but if there be two Figures in a Rhomboyades (as for the most part there is) then add them two Figures together, and set down their sum in one Figure.

IV. But if the sum of the two Figures in one Rhomboyades or Diamond do exceed Ten, then you must set down the overplus above Ten, and keep One in minde, which One you must carry to the next Rhomboyades.

V. Note that the first towards your
right

right hand, and the last towards your left hand are but half Rhomboyades or Diamonds, and never have in them more then one Figure onely, but all between them are whole ones, and for the most part have two Figures in them.

VI. If in either Rhomboyades or half Rhomboyades, you finde no Figures but Cyphers, you must not neglect but set them down as if they were Figures.

¶ These Rules being rightly understood, all that follows will be familiar and easie, and these I shall explain by Example following.

Example.

For the illustration of the preceding Rules, we will make use of those Rods which were before tabulated,

C

lated,

lated, therefore have recourse to *Figure 4* at the beginning of the Book, where this Number 3496 is tabulated.

The Figures at the top of the Four Rods are these 3, 4, 9, 6. which signifie the former given number 3496, and this number stands against the figure 1 on the side of the Tabulat. Then I say, that the figures in the next row standing against the figure 2 of the Tabulat and double thereunto, which I thus prove.

Repair to the Rods as they lie upon the Tabulat, and in that row which lieth against the figure 2, you shall finde in the first half Rhomboyades towards your right hand (where by *Rule 1* you must begin) the figure 2, wherefore set down with your Pen upon Paper the figure 2. In the next Rhomboyades, in the same row you shall finde 8 and 1, which added make 9, set down 9 on the left hand of

of 2 : In the next Rhombus you shall finde 8 and 1 again, which is 9 also, set down 9 on the left hand of the other, and in the last Rhomboyades you shall finde only 6, wherefore set down 6 on the left hand of 9, so have you in all 6992, which is double to 3496.

Again, the figures in the row which stands against the figure 3 in the Tabulat, are triple to 3496 ; for in the first half Rhomboyades towards your right hand, you have 8, set down 8.-- In the next Rhom. you have 7 and 1, which is 8, set down 8 again.-- In the next you have 2 and 2, which is 4, set down 4.--- In the next Rhom. you have 9 and 1, which makes 10, set down 0 and carry 1, but it is the last Rhom. and because there is never another to carry the 1 unto, you must therefore set it down, so have you this number 10488, which is triple to 3496.

Again, the figures standing against 4 in the Tabulat, are Quadruple to 3496,--- for in the half Rhom. you have 4, set it down: in the next 6 and 2, which is 8, set that down. In the next 6 and 3 which is 9, set that down: In the next 2 and 1, which is 3, set that down: and in the last half Rhom. you have 1, which also set down: so have you 13984 which is Quadruple to 3496.

Also, the figures against 5 in the Tabulat: the first is a Cypher therefore put down 0; the next is 5 and 3 which is 8, set down 8; the next is 0 and 4, set down 4; the next is 5 and 2, that is 7, set down 7; and the last is 1, therefore set down 1, so have you in all 17480, which is Quintuple to 3496.

Against 6 in the Tabulat, you have in the first place 6, set it down; then, in the next 4 and 3, that is 7, set that down; in the next 4 and 5, that

is 9, set 9 down; in the next you have 8 and 2, that is 10, set down 0 and carry 1 to the next Rhom. where you finde onely 1, to which add the 1, which you carried from the Rhom. before, and it makes 2, set down 2: so have you 20976, which is six times 3496.

Against 7 in the Tabulat, you have first 2, set it down; then 3 and 4, which is 7, set 7 down; in the next 8 and 6, which is 14, which being above 10, set down 4, and carry 1 to the next Rhom. where you have 2 and 1, which is 3, and 1, which you carried makes 4, set down 4; then in the last place you have onely 2, which set down, so have you in all 24472, which is Septuple to 3496, or seven times as much.

Against 8 in the Tabulat, you have first 8, which set down; then 2 and 4, which is 6, set 6 down; then 2 and 7, which is 9, set 9 down; then 4 and 3,
 C 3 which

which is 7, set 7 down; and lastly 2, set that down, so have you 27968, which is Octuple to 3496, or eight times as much.

Lastly, against 9 in the Tabulat, you have in the first place 4, set that down; in the next you have 1 and 5, which is 6, set 6 down; in the next place you have 6 and 8, which is 14, set down 4, and carry 1 to the next Rhom. where you finde 7 and 3, that is 10, which with 1 which you carried makes 11, set down 1, and carry 1 to the next Rhom. where you finde onely 2 and the 1 carried makes 3, therefore set down 3, and so you have 31464, which is Noncuple to 3496, or nine times as much as the tabulated number.

Thus have I given you Examples, in shewing you how the Numbers upon the Rods are to be read and written down, and in the delivery of this Example, I have made the whole
work

work which is to follow so plain and easie, that the meaneſt capacity (I think) if he can but tell his figures, and add any two figures together, he may by this here delivered, read or write down any number that can be tabulated ; and that you may thoroughly underſtand this Chapter before you proceed further, I will give you the Products of 7009078 multiplied by all the nine Digits which I would have your ſelf to tabulate, and ſee if you finde your working by your Rods to agree with thoſe which are here written, which numbers if they do, you need not ſcruple at the moſt difficult that can be propoſed to you, therefore ſtudy it, and try it.

			7009078
	2		14018156
	3		21027234
	4		28036312
7009078	5		35045390
being mul-	6		42054468
tiplied by	7		49063546
	8		56072624
	9		63081702

Producth

Thus have I sufficiently described these Rods and the manner of Numbring upon them; and now I think it time to apply them to that use for which they were intended, namely, the more difficult parts of Arithmetick, as Multiplication, Division, and Extraction of Roots, but first let me give you

An Admonition concerning Addition and Subtraction.

Whereas it was the difficult operations of Arithmetick, which by the benefit

benefit of these Rods, the Inventor chiefly aimed at (of which kind he esteemed *Multiplication*, *Division*, and *Extraction of the Square and Cube Roots*) he omitted to say any thing concerning *Addition* and *Subtraction* in things obvious to every Tyro, he therefore omitting them, begins to shew the use of his Rods in *Multiplication*, whose Method I shall here follow.

CHAP. VI.

Multiplication by the Rods.

IN Multiplying by the Rods, you are to consider (as in vulgar Arithmetick) three Terms, Things, or Numbers, viz.

1. The *Multiplicand*, which is the Number to be multiplied.

C 5

2. The

2. The *Multiplier*, which is the Number by which the *Multiplicand* is multiplied.

3. The *Product*, which is the Sum produced by the multiplying of the two former together.

And here note, that the *Product* doth contain the *Multiplicand*, so many times as there be *Units* in the *Multiplier*.

Thus for the definition of *Multiplication*, now for the working thereof by the Rods, for which this is

T H E R U L E :

First, Set down upon your Paper the *Multiplicand*, and orderly under it the *Multiplier*. It matters not greatly which of the two given Numbers be made *Multiplicand* or *Multiplier*, but it is usual and best to make the greatest Number *Multiplicand*, and the lesser *Multiplier*. Then draw

draw a Line with your Pen under them, and having Tabulated your Multipl-
 cand (or greater number) look what
 Numbers in your Rods stand against
 the first Figure towards your right
 hand, and that Number which you
 shall finde upon your Rods standing a-
 gainst that first Figure found in your
 Tabulat , set down under your Line
 which you formerly drew under your
 Multiplicand and Multiplier : And
 having so done with the first Figure of
 your Multiplier, do so with the rest,
 setting them down one under another,
 removing every Figure one place more
 towards the left hand, then that which
 went before it, as is done in common
 Multiplication, and as you see in the
 following Example.

Example 1. Let it be required to
 multiply 3496, by 489. As if it were
 required to know how much 489
 times 3496 would amount unto.

First, Set down your given Num-
 ber

bers 3496, and 489, one under another, and draw your Line under them, as here you see done.

Secondly, 3496 your Multipli-
cand being Tabulated, and 9 being

3496 Multiplicand, the first Fi-
gure to the

489 Multiplier, gure to the
right hand

31464

27968

13984

1709544 Product.

Sec.

in your
Multiplier,
look upon
your Rods,
what sum

there stands against 9 in the side of
your Tabulat, and you shall finde (as
by the Rules in the second Prop. of
the Fifth Chap. you were directed)
31464, which is the Product of 3496
multiplied by 9, wherefore set down
this number 31464 under your Line,
as you see in the Example.

Thirdly, Look what sum upon the
Rods stands against 8, which is the
second Figure of your Multiplier, and
you

you shall finde 27968, set this number under the former, moving it one place forward towards the left hand.

Fourthly, Look what sum upon the Rods stands against 4 which is the third Figure in your Multiplier, and you shall finde 13984, which set down under the other, one place more to the left hand.

Lastly, Under these three Sums draw a Line and add the three sums together, and they make 1709544, which is the Product of 3496 multiplied by 489, and this 1709544 the Product, contains 3496 the Multiplicand, 489 times.

Practise well this first Example, and compare it with the Rods as they are Tabulated in Figure 4 at the beginning of the Book, as also with the Rules in the Fifth Chapter, and you may perform any Multiplication. However I will give you one or two more.

more Examples, and some other ways of *Multiplication*.

Example 2. *Let it be required to multiply the same sum 3496 by 261.*

3496	Set the Numbers down as here is done, then look upon the Rods for the Product of 3496 by 1, and you shall finde it to be the same, wherefore set down 3496 under the Line—
261	
<hr/> 3496	
20976	
6992	
<hr/> 912456	

then look upon the Rods for the Product of 3496 by 6, and you shall finde it to be 20976, which set down under the other number one place more towards the left hand.—Again, look in the Rods for the Product of 3496 multiplied by 2, and you shall finde it to be 6992, which set down under the other two.

Lastly, Draw a Line under them, and add the three numbers together in order as they stand, and the sum
of

of them will be 912456, which is the Product of 3496 multiplied by 261.

Example 3. *Let it be required to multiply the same number 3496 by 520.*

Set down your Numbers as here you see done— Then because the first Fi-

3496 gure of your Multiplier to-
520 wards your right hand is a

6992 Cypher, wholly omit it,
17480 and multiply 3496 by 52

1817920 only, so shall you finde the
Product of 3496 by 2 to

be 6992, which set down: Also the
Product by 5 will be 17480, which

set down under the other one place
farther, Then draw a Line ——— and

add these two sums together, and they
make 181792, to the which if you

add a Cypher for the Cypher which
you omitted in your Multiplier, the

sum will be 1817920, which is the
Product of 3496 by 520.

Example 4. *Let it be required to
multiply*

multiply the same 3496 by 7003—

Set down your Numbers as before, and as you see here done, Then ha-

ving Tabulated 3496, see

$$\begin{array}{r} 3496 \\ 7003 \\ \hline 10488 \\ 24472 \end{array}$$

 what the Product thereof
 is upon the Rods being
 multiplied by 3 the first
 Figure in your Multi-
 plicier, and you shall finde
 it to be 10488, which set down un-
 der the Line—— Then the two next
 places of your Multiplier being Cy-
 phers, make two pricks under the
 former number, one under 8, the o-
 ther under 4, as you see in the Ex-
 ample, or instead of 2 pricks you may
 make two Cyphers,—Then look in
 the Rods for the Product of 3496
 by 7, and you shall finde it to be
 24472, which set down under the o-
 ther sum, beginning your number at
 the fourth place, or beyond the two
 Pricks or Cyphers. Lastly, draw a
 Line and add these two sumstoge-
 ther,

ther, and their sum is 24482488, which is the Product of 3496 multiplied by 7003.

Thus have you four Examples in *Multiplication*, in which are included all the Varieties that may at any time happen in that Rule, *viz.* Two where the Multiplier consisted all of Figures, as in the first and second Example they did.—Another where the latter place of the Multiplier consisted of a Cypher—And this last Example where Cyphers were intermixed among the Figures.

And thus much for this kinde of Multiplication, but before I leave, I will shew you

Another Form of

M U L T I P L I C A T I O N.

Whereas in the foregoing Form of Multiplication, which is the best and
most

most usual, (only I insert this following for variety.) You began (your Rods being Tabulated) with that Figure of your Multiplier which stands next your right hand, but there is no necessity for that, for you may begin with that Figure which standeth next to your left hand, and by so doing, and placing your several Products one place more to the right hand, as you did before place them to the left hand, those Products added together in the Form they then stand, shall produce a Product equal to the former.

Example, For our Example we will take the first Example before-going at the beginning of this Chapter, where it was required to multiply 3496 by 489. Set the Numbers down as before in that first Example, and as you see here done-----

3496

$$\begin{array}{r}
 3496 \\
 489 \\
 \hline
 13984 \\
 27968 \\
 31464 \\
 \hline
 1709544
 \end{array}$$

Then 3496 being Tabulated, look upon your Rods for the Product thereof multiplied by 4, (which is the first Figure of your Multiplier towards your left hand) and you shall finde the Product thereof to be 13984, which set down.—Secondly, look the Product of 3496 by 8 (your second Figure) and you shall find it to be 27968, which must not be set down as in the other first Example but as you see it in this, 8 the first Figure thereof must be set one place forwards towards the right hand, as in the other it was set a place backward towards the left.—Lastly, seek in your Rods for the Product of 3496 by 9 your last Figure, and you shall finde it to be 13984, which set under the other two Numbers yet one place more to the right hand.—So a Line being drawn under, and these three Numbers

Numbers added together produce 1709544 equal to that in the first Example: And that you may the better see the difference of the work, I have set them one by the other.

As in the
first Ex-
ample,

$$\begin{array}{r}
 3496 \\
 489 \\
 \hline
 31464 \\
 27968 \\
 13984 \\
 \hline
 1709544
 \end{array}$$

As in this
Example,

$$\begin{array}{r}
 3496 \\
 489 \\
 \hline
 13984 \\
 27968 \\
 31464 \\
 \hline
 1709544
 \end{array}$$

One Example more in Multiplication, which shall be for Advertisement and direction, I will give, and so conclude Multiplication.

I said in the general Rule for working of *Multiplication* (at the beginning of this Chapter) that it mattered not which of your Numbers were

were made the Multiplicand, or which the Multiplier, of which I will here give you a President where the lesser Number shall be Tabulated, and the greater Number only set down; and I will work it here according to this last way of Multiplication, and the Example shall be as followeth.

Example, *Let it be required to multiply 868437 by 3496, and let 3496 (the lesser Number) be Tabulated.*

Let the Numbers be set as you here see, then 3496 being Tabulated, begin with the first Figure towards the left hand of your Multiplier, which here is 8, and upon your Rods find the Product of 3496 multiplied by 8, which is 27968, set that down under the

3496	
868437	
<u>27968</u>	
20976	
27968	
13984	
10488	
<u>24472</u>	
3036055752	

Line

Line — then finde the Product of 3496 by 6 the second Figure of your Multiplier, and you shall finde that to be 20976, set this number under the former one place more towards the right hand.—Again the third Figure of your Product is 8 whose Product is 27968 as before, set that under the other still one place more to the right hand.—In this manner do with the other Figures of the Multiplier, as 4 the next Figure, whose Product is 13984, which also set down a place forward.—So also the Product of 3 which is 10488, which set down.—And lastly, of 7, which is 24472.—All these Products being set down in the order as you see them in the Margent, if you add them together, the sum of them will be 3036055752, which is the Product of 3496 multiplied by 868437, the lesser number being Tabulated.

Other

Other ways of Multiplication I could have added, but these I esteem sufficient.

CHAP. VII.

DIVISION

By the Rods.

AS in Multiplication, so in Division there are three Numbers, Terms, or Things required, viz.

1. The *Dividend* or Number to be divided.

2. The *Divisor* or Number by which the Dividend is divided, and

3. The *Quotient*, which is the Number issuing from the Dividends being divided by the Divisor; And this *Quotient* doth always consist of so many *Unites* as the *Divisor* is times

times contained in the *Dividend*.

Thus much for the *Definition* of *Division*, now let us come to the *Practice* of it by the *Rods*, to perform which, this is

THE RULE

Tabulate the *Divisor*, (which is always the lesser Number of the two given) and set down the *Dividend*, and set the *Divisor* on the left hand, and draw a crooked Line on the right hand for your *Quotient*, as in common *Arithmetick*. Then look upon your *Tabulated Rods* (always) for the Number, less then the Number in the first Figures of your *Dividend*, and what Figure stands against that Number on the edge of your *Tabulat* must be the Figure you must put in your *Quotient*, and that Number you must always subtract from the Figures of your *Dividend*, and to the remainder add another

ther Figure, so proceeding from Figure to Figure till your Division be wholly ended.

Example, Let it be required to divide 1709544, by 3496. Having tabulated 3496, set down your Dividend, your Divisor on the left hand thereof, and a crooked Line for the Quotient on the right hand thereof, as by the Rule preceding you were directed, and as you see done in the Example adjoining.

And because at your first setting down of your Divisor 3496, it would reach (if it were set under your Dividend 1709544) as far as the Figure 5, therefore under the Figure 5 make a Prick to intimate how far you are gone on in your work, and under this Prick draw a Line quite under your Dividend, then is your Sum set down ready for work, and will appear as here you see ;

D

3496)

(50)

3496) 1709544 (

Your Sum thus prepared, ask how often can you have 3496 in 17095, look in your Tabulated Rods for 17095, which you cannot there finde, but the nearest number thereunto amongst the Rods, which is less then 17095 (for you must always take a less number) is 13984, which number stands against the Figure 4 in the Tabulat, wherefore set 4 in your Quotient, and 13984 under the Line, and subtract 13984 from 17095, and there will remain 3111, so is the first part of your Division ended and your work will stand thus;

3111
3496) 1709544 (4

13984

Then make another Prick under 4 the next Figure of your Dividend, so will

will the remaining number be 31114,
 —Then look among your Rods for
 the number 31114 (or the nearest
 less then it) and the nearest less you
 shall finde to be 27968, which stands
 against 8 in your Tabulat, put 8 in
 your Quotient, and set 27968 under
 31114, and substract 27968 from
 31114, so will there remain 3146,
 which set over head, so is the second
 part of your Division ended, and your
 work will appear thus ;

$$\begin{array}{r}
 3146 \\
 3111 \\
 3496 \overline{) 17095.44} \quad (48 \\
 \underline{13984} \\
 27968
 \end{array}$$

Lastly, Make another Prick under
 the next Figure of your Dividend,
 which is 4 also, making the remain-
 ing number to be 31464, seek a-
 mong

mong your Tabulated Rods for this number (or the nearest less) but looking you shall finde the very number, against which stands on your Tabulat the Figure 9, set 9 in the Quotient, and the number 31464 under the Line, and subtract it from 31464 the remainder which stands above the Line, and nothing remains, and being there is never another Figure in your Dividend, your Division is ended, and your work will stand thus, and 3496 is contained in 1709544 489 times.

$$\begin{array}{r}
 00020 \\
 3146 \\
 3111 \\
 \text{Divisor, } 3496 \bigg) 1709544 \text{ (Quotient} \\
 \qquad \qquad \qquad \dots \qquad \qquad 489 \\
 \hline
 13984 \\
 27968 \\
 31464
 \end{array}$$

Another

Another Example, and by another way of Division.

Let it be required to divide 912456 by 3496, set down your Dividend and Divisor, draw a crooked Line for your Quotient, and also make a Prick under the fourth Figure of your Dividend, and draw a Line under your Dividend, so is your Sum prepared to be divided, and will stand thus ;

$$\begin{array}{r} 3496 \) \ 912456 \ (\\ \hline \end{array}$$

Then your Divisor 3496 being Tabulated, look amongst your Rods for the nearest number to 9124 which is less, and you shall finde it to be 6992, against which stands on your Tabulat the Figure 2, set 2 in the Quotient, and this Number under the Line, and subtract it from 9124, and there will remain 2132, to which

D 3

number

(54)

number add the next **Figure** of your Dividend, namely 5, and it makes 21325, under which number draw a Line, then will your Sum stand thus,

$$\begin{array}{r} 3496 \quad) \quad 912456 \quad (\quad 2 \\ \underline{6992} \\ 21325 \end{array}$$

Then among your Rods seek the nearest number to 21325 and you shall finde 20976 to be the nearest number less, against which in your Tabulat stands 6, set 6 in the Quotient, and 20976 under the Line, subtracting it from 21325, which when you have done, there will remain 349, to 349 add the next **Figure** in your Dividend, which is 6 your last **Figure**, and it makes 3496, under which draw a Line, and your work will stand as here you see,

3496

(55)

$$\begin{array}{r} 3496 \overline{) 912456} \quad 26 \\ \quad \quad \quad \dots \\ \underline{6992} \\ 21325 \\ \underline{20976} \\ \quad 3496 \end{array}$$

This done, look amongst your Rods for the nearest number to 3496, and you shall finde the exact number at the top of the Rods, against which stands the Figure 1 on the Tabulat, set 1 in the Quotient, and subtract 3496 from 3496, the remainder is nothing, and so is your Division ended, the work standing thus, and 3496 the Divisor is contained in 912456 the Dividend, 261 times.

D 4

3496

(56)

$$\begin{array}{r} 3496 \) \ 912456 \ (\ 361 \\ \underline{\hspace{1cm}} \\ 6992 \\ \underline{\hspace{1cm}} \\ 21325 \\ \underline{\hspace{1cm}} \\ 20976 \\ \underline{\hspace{1cm}} \\ 3496 \\ \underline{\hspace{1cm}} \\ 3496 \\ \underline{\hspace{1cm}} \\ 0000 \end{array}$$

A third Example ready wrought by the last and best way of Division. I will only set it down ready wrought, leaving the practice of it to your self.

Let it be required to divide 73020506 by 3496.

3496

(57)

$$3496 \overline{) 73020506} \left(20886 \frac{3050}{3496}$$

6992

31005

27968

30370

27968

24026

20976

3050

This Sum thus divided, produceth in the Quotient 20886, and 3050 remaining, so that the Quotient with Fraction and all is,

$$20886 \frac{13050}{3496} \text{ Which shews}$$

that 3496 the Divisor is contained in 73020506 the Dividend, 20886 times, and 3050 remaining.

D 5

This

This Example well practised, together with them before-going, are sufficient instruction for any Student whatever, and he that can perform these need not despair of the most difficult that can be proposed. And so I conclude with Division.

CHAP. VIII.

Concerning the

Rule of Three

OR

Golden Rule,

*Both Direct and Reverse, or
Reciprocal.*

TO Discourse of this Rule at large were to run into a Labyrinth, for
it

it was the performance of working Multiplication and Division by the Rods that was here aimed at, and he that can Multiply and Divide may command this *Golden Rule*, wherefore I will shew you the nature or order of placing the Numbers, and also the manner of working an Example in either of them.

The *Rule of Three* is that Rule which teacheth by having three Numbers in proportion one to another given, to finde a fourth, which shall be in proportion to them also.

In this *Rule direct* the fourth Number which is sought, is to have the same proportion to the third, as the second Number hath to the first : As if the three Numbers given were 2--4-- and 8, say, as 2 is to 4, so is 8-- to what? multiply 4 by 8 (that is the second Number by the third) and the Product will be 32, which divide by 2 (the first Number) the
Quotient

Quotient will be 16, which is the fourth Number in proportion to the third, as the second is to the first; for as 4 the second Number, contains 2 the first Number twice, so 16 the fourth Number contains 8 the third Number twice also.

But in the *Reciprocal Rule of Three*, there the proportion is not as the first to the second, so the third to the fourth: But *as the First is to the Third, so is the second to the Fourth*. As if the Numbers were 3, 4, and 6, say, As 3 the first Number, is to 6 the third Number, so is 4 the second Number; to what? Multiply 4 the second Number by 3 the first Number, the Product is 12, which divide by 6 the third Number, and the Quotient will be 2; for as 6 the third Number, contains 3 the first Number twice, so 4 the second Number contains 2 the fourth Number twice also: And in this consists the difference

ference between the *Direct* and *Reciprocal Rule of Three*.

A Question in each Rule,

1. *In the Direct Rule ;*

If four Men eat two Pecks of Corn in one week, how many Pecks will serve an hundred Men the same time ?

Men	Pecks	Men.
4	2	100.

Multiply 2 the second Number by 100 the third Number, the Product will be 200, which divide by 4 the first Number, and the Quotient will be 50, and so many Pecks will suffice 100 men the same time.

2. *In the Reciprocal,*

If twelve men do any piece of work in
8 days,

8 days, how many men must be employed to do the same piece of work in 2 days?

Days	Men	Days.
8	12	2.

Multiply 8 the first Number, by 12 the second, their Product is 96, which divide by 2 the third Number, the Quotient will be 48, and so many men will do the same work in 2 days, for as 8 days is to 2 days, so are 12 men to 48 men, &c.

CHAP. IX.

Of the Extraction of
ROOTS.

THe Extraction of *Roots*, which is the difficultest part of Multiplication and Division, is expeditiously and certainly performed by the Rods, for the easie and expedite performance of which, there are two Rods on purpose, one for the Square, the other for the Cube Root, of which I will speak; first, Of their Fabrick: secondly, of their Use.

Of the Fabrick of the Rods for Extracting of Roots.

Of the same matter, and of the same length and thickness of your other
 ther

ther Rods, let there be made another Rod but three times the breadth of the former, the Inscription on one side serving to extract the Square, and that on the other side for the Cube Root, each of which are divided into three Rows or Columes.

That which serveth for the Square Root, hath in the top or uppermost Square between the Diagonal thereof, these Figures 0-1, in the second 0-4, in the third 0-9, in the fourth 1-6, in the fifth 2-5, in the sixth 3-6, in the seventh 4-9, in the eighth 6-4, and in the ninth or lowermost 1-8, which are the Square Numbers belonging to the nine Digits. —

In the second Colume of the same Rod, in the first Square is inscribed 2, in the second 4, in the third 6, in the fourth 8, in the fifth 10, in the sixth 12, in the seventh 14, in the eighth 16, and in the ninth 18.

In the last or third Colume there
are

are the nine Digits orderly descending, namely, 1, 2, 3, 4, 5, 6, 7, 8, 9. This Rod thus made is fitted for the Square Root.

That which serveth for the Cube Root, hath in the top or uppermost Square of the first Colume towards the left hand between the Diagonal thereof, these Figures, 0-01, in the second 0-08, in the third 0-27, in the fourth 0-64, in the fifth 1-25, in the sixth 2-16, in the seventh 3-43, in the eighth 5-12, and in the ninth 7-29, which are Cube Numbers orderly descending — The second Colume of this Rod contains these square Numbers, 1, 4, 9, 16, 25, 36, 49, 64, 81, orderly descending. — The third and last Colume of this Rod hath in it the nine Digits, 1, 2, 3, 4, 5, 6, 7, 8, 9, orderly descending also.

This Rod thus prepared and inscribed, is fit for extracting of the
Square

Square and Cube Roots, a Figure of either side whereof you have at the beginning of the Book : That which serveth for the Square Root having the word *Square* written over head, that for the Cube Root, hath *Cube* written over head.

Thus having given you the Fabrick and Inscription of these Rods, I will now shew you their use ; And first,

Concerning the Extracting of the Square-Root.

In Extracting of the Square-Root, you must as in common Arithmetick, when you have set down your Number, make a Prick under the first Figure towards your right hand, and so successively under every second Figure, then under those Pricks, draw two Lines parallel whereinto set the Figures of your Root as you finde them : Your Number being thus placed

ced and pricked as before is directed, and as in the following Example you see done, you may proceed to Extract the Root thereof as followeth.

Example 1. Let it be required to finde the Square-Root of this Number 12418576, first, make a Prick under 6, another under 5, another under 1, and another under 2, under which Points draw two Lines, in which you must place your Root, and then will your Number stand thus,

12418576

. . . .

Take the Rod for Extracting of the Square-Root, and look in the first row or Colume thereof for the nearest Number you can there finde less then 12 (which is as far as the first Prick in your Number reaches) and you shall

shall finde 9, against which in the third Colume you shall finde 3, set 3 under the first point between the Lines, and 9 under the Line, and subtracting 9 from 12, there will remain 3, which set over 12, so will your Number stand thus;

$$\begin{array}{r}
 3 \\
 12418576 \\
 \cdot \cdot \cdot \cdot \\
 \hline
 3 \\
 \hline
 9
 \end{array}$$

Then in the middle Colume of your Rod between 9 and 3 there stands 6, take therefore one of your Rods which hath 6 at the top thereof, and lay it upon your Tabulat by the left side of your square Rod, then being there is 341 to the next Prick, seek the nearest Number less upon your two Rods, and you shall finde the next less to be 325, against which in the last Colume of your Square Rod stands 5, therefore place 5 under your second Prick, and set 325 under 341, and subtracting it

it from 341, there will remain 16,
which set over head, then will the
Sum appear thus ;

$$\begin{array}{r}
 16 \\
 3 \\
 12418576 \\
 \cdot \cdot \cdot \cdot \\
 \hline
 3 \quad 5 \\
 \hline
 9 \\
 325
 \end{array}$$

And in the middle
Colume of your Square
Rod against this 5
there stands 10, for
this 10 you should take
a Rod that hath 10 at
the top, but being
there is no such, take
therefore one that hath a Cypher, and
place that between your Square Rod
and your Rod of 6, and change your
Rod 6 for one of 7, then shall you
Thus must you al- have upon your
ways do when the Tabulat one Rod
Number in the of 7, another of 0,
middle Colume and your Square
exceeds 10. Rod.

Then looking upon your Sum you
shall finde 1685 to your third Prick ;
look therefore upon your Rods for the
nearest

nearest less Number, which you shall finde to be 1404, against which stands 2 in the last Colume, set 2 between the Lines under the third Prick, and 1404 under 1685, and substracting it from 1685, and there will remain 281, which place above, so will your Sum stand thus ;

$$\begin{array}{r}
 281 \\
 16 \\
 3 \\
 12418576 \\
 \cdot \cdot \cdot \\
 \hline
 3 \quad 5 \quad 2 \\
 \hline
 9 \\
 325 \\
 1404
 \end{array}$$

And because the Number standing against in the middle Colume of your Square Rod between 1404 and 2 was 4, set 4 under your last Prick, and take a Rod of 4, and put it between your square Rod and your Rod of 0 ;

and because 28176 remains upon your Sum to the last Prick. Look upon your Rods for the nearest Number thereunto, and you shall finde the very Number it self to stand against the
Figure

(71)

Figure 4, set therefore 28176 below, and subtract it from that above, and there will remain nothing, which denotes the Number 12418576 to be a square Number, and the Root thereof to be 3524, and the work finished will stand thus;

$$\begin{array}{r} \text{Square} \quad 12418576 \\ \quad \quad \quad \cdot \quad \cdot \quad \cdot \quad \cdot \\ \hline \quad \quad \quad 3 \quad 5 \quad 2 \quad 4 \quad \text{Root.} \\ \quad \quad \quad 9 \\ \quad \quad \quad 325 \\ \quad \quad \quad 1400 \\ \quad \quad \quad 28176 \end{array}$$

This Sum had it been wrought by that second way of Division, which I shewed in Chapter 7, it would stand as followeth;

Square

(72)

Square 12418576 (3524 Root.

$$\begin{array}{r}
 9 \\
 341 \\
 \hline
 325 \\
 1685 \\
 \hline
 1404 \\
 28176 \\
 \hline
 28176 \\
 00000
 \end{array}$$

Caution.

If at any time you look for the remainder upon your Rods, and you cannot finde it there, you must then place a Cypher between the Lines, and proceed to the next Figure, as by trying this other Example which I have inserted for practice will appear.

Another

(73)

*Another Example added for
Practice.*

$$\begin{array}{r} 90 \\ 54895 \\ 67 \\ 21 \\ 2 \\ \cdot \cdot \cdot \cdot \cdot \cdot \\ 117716237694 \\ \hline 343098 \\ \hline 9 \\ 256 \\ 2049 \\ 617481 \\ 5489504 \\ \hline \end{array}$$

CHAP. X.

*Concerning the Extraction of the
Cube Root.*

THere is somewhat more difficul-
ty in Extracting of the Cube,
E then

then of the Square Root. Wherefore (before I come to Example) I will deliver the manner of the Operation, together with such Cautions as are to be observed in the performance thereof; All which immediately follow in this

GENERAL RULE.

Write down the Number whose Cube Root you are to Extract, and under the first Figure towards the right hand make a Prick or Point, and so under every third Figure towards the left hand, till you come to the end of your Number. Under these Pricks draw two Parallel Lines, (as you did in Extracting the Square Root) between which Lines you are to place the Figures of your Root as you finde them; — Then beginning at the Figure (or Figures) of the left hand Prick, and going forward towards the right hand, Extract (by help of the Rod for Extracting

tracting the Cube Root) their Root,
 (or if the true Number be not on the
 Plate, then the nearest less, and pla-
 cing this Root, (which never exceeds
 one Figure) between the Lines, and
 under its Point, and take its Cube from
 the uppermost Figures, which stand be-
 fore (or leftwards) of the first Point,
 and note the Remainder above.

Secondly, Keep the Triple of this
 Root sound, in the head or top of the
 Rods, and triple the Square of the
 same Root, and set this Triple on the
 head of the Rods, and apply it left-
 wards of the Cubick Rod, and the re-
 served Rod (or Rods) right-wards, the
 Cubick Rod being in the midst between
 them, and out of the left hand Rods and
 the Cubick Rod together, pick or finde
 out the Multiple, (or next less Num-
 ber) then the Figures preceding the se-
 cond Point, which write apart in a Pa-
 per, and note its Quotient over its ut-
 most right-hand Figure, and write the

E 2

Square

Square of that Quotum left-wards
 from the Quotum it self, even in that
 order as you finde them in your Cubick
 Rod, and under every several Figure
 of this Square, write their Multiples
 found right-wards, even such as the
 Figures themselves do shew. So that
 every Multiple may end under its Fi-
 gure or Quotum; then add together
 these Multiples cross-wise, and take
 their sum from the Figures foregoing
 the second Point, and write the Re-
 mainder over them, but write the
 right-hand Quotum before noted un-
 der the second Point between the Lines,
 for the second Figure or Quotum of
 the Root: And so is performed the
 Operation of the second Point, which
 you must repeat through the several
 Points, even to the last.

But in the practice by this Rule,
 you may sometimes be at a stand,
 wherefore to this **GENERAL**
RULE

RULE (that there may be no obstacle). I will add these two *C A U T I O N S*.

I. C A U T I O N.

But in all Operations and Points it must be observed, That if no *Multiple* (no not the least of all) found in the left Rods, and the plate, may be subtracted from the foregoing Remains, then a Cypher [0] must be put under that Point for the *Quotient*, the Remains being untouched, and abiding as before.

II. C A U T I O N.

And if the aforesaid Sum to be taken away, cannot be taken from the Figures going before its Point, the smaller Multiples must be added, which the next upper *Quotients* in the

E 3

Cubick

(78)

Cubick Rod do shew in the Rods, whose Sum may be taken away therefrom.

EXAMPLE

Of the

Cubick Extraction.

Let 22022635627 be a Number given, whose Cube Root you desire : Set down your Number, and point it, (beginning at 7 the last Figure towards the right hand, and so under every third Figure) and draw two Parallel Lines under it, and it will stand in this manner ;

2 2 0 2 2 6 3 5 6 2 7

.

Look

Look in your Rod for the Extra-
 cting the Cube Root, for the near-
 est Cube Root of the Figures of your
 given Number standing before the
 first Point towards your left hand,
 namely for the nearest Cube Root of
 the Number less then 22, which
 you shall finde to be 2, which set be-
 tween the two Lines just under the
 first Point, and its Cube (which is 8)
 set under the Line, and subtract it
 from the Figures above the Line,
 namely from 22, and there will re-
 main 14, which place orderly above,
 then will your work stand thus, and
 the work of your first Point finished.

$$\begin{array}{r}
 14 \\
 22022635627 \\
 \cdot \quad \cdot \quad \cdot \quad \cdot \\
 \hline
 2 \\
 \hline
 8
 \end{array}$$

E 4

Secondly,

Secondly, For the finding of the Root belonging to the second Prick, triple the Quotume or Figure which is under the first Prick (namely 2) and it is 6, finde therefore a Rod which hath 6 at the head thereof, and lay that Rod by the side of your Cubick Rod towards the right hand, then triple the Square of 2 (which is 4) and it makes 12, which found among the Rods, place by the side of the Cubick Rod towards the left hand.

Then from the Rods which lie on the left hand of the Cubick Rod, and the Cubick Rod it self, finde the nearest lesser Number then the Figures standing before the second Prick, namely, less then 14022, and in the ninth place you shall finde 11529, which write by it self as

(81)

in the Margine, and over
9 the last Figure towards
the right hand (drawing
first a Line between) set
its Quotume, and by it
its Square 81, in the
same order as you finde
them stand in your Cubick Rod.

819
———
11529
6
48
———
16389

Then write under 1, its Multiple,
which is shewed right-wards against
1 in the Cubick Rod, and is the sin-
gle Figure 6, and under 8 write the
Multiple that it shews right-ward a-
gainst 8 in the Cubick Rod, which is
48, and these three Multiples so
written cross-wise below the Line,
and added together (as in the Mar-
gine) do produce 16389; which,
because they cannot be taken from the
upper Figures standing before the se-
cond Point, namely from 14022, the
Number 9 (before taken) is to be
rejected, as being too great, and in-
stead of 819 (by the second Cau-
E 5 tion)

tion) the next higher Notes in the Plate are to be taken, which are 648, and the Multiples that these do shew, namely the Octuple among the left Rods, which is 10112, and the Quadruple among the right Rods which is

648	24, and the Sextuple among the right Rods,
— — —	which is 36, being added
10112	cross-wise (as in the
24	Margine) do produce
36	13952, which subtracted
— — —	

13952 from 14022, (the Figures standing before the second Prick) there remains 70 for the remain of the second Prick, and let there be taken for the Quotune of the second Prick, the right-most of the chosen Figures 648, which is 8, which place under the second Point between the Lines; so is the second Figure of your Root found, and your work will stand thus,

70

14

22022635627

2 8

8

13952

Thirdly, Put the Triple of the precedent Quotumes (*viz.* 28 between the Lines) which is 84, being taken out of the Rods, and put them on the right-side of the Cubick Rod, and get the Triple of the Square of the same 28, which may be found to be

28

28

224

56

784

3

2352

2352, which taken out of the Rods and place on the left-side of the Cubick Rod: And of the Multiples on the left-hand Rods, and the simple single Figures upon the Cubick Rod (the least

which is 840 on the right-hand, and
the Triple of the Square of the same
280; which is 225200
on the left-hand, and
the Cubick Rod be-
tween them; Then out

280

280

of the left-most Multi-
ples, choose that which
is next less then the Fi-
gures belonging to the
fourth Point, namely

22400

560

70635627, which is
this 70560027,

235200

which stands against 3 on the Ta-
bulat, wherefore write this Number
70560027 upon Paper as in the
Margine, with a Line over it, and set
over the Line the

78400

3

Quotient 3, over its
right-most Figure, and
the Square of the said
Quotume 3, which is

93

9, left-ward thereof,

70560027

7560

and the Noncuple found in the right-
hand

70635627

hand Rods, which is 7560 write under 9, let these two Multiples be added as in the Margine, and the Sum will be 70635627, which subtracted from the Figures foregoing the fourth Prick, and there will nothing remain; therefore let the right-most of the Figures of 93, viz. 3, be placed under the fourth and last Point, for the fourth and last Quotume of the Root, and so the whole and perfect Cubick Root of the given Number 22022635627, is 2803, and being nothing remained, it is a perfect Cubick Number. The like is to be done in other Numbers, but I shall forbear to give you any more Examples, there falling out in this all the variety that at any time may happen for the *General Rule* and the two *Cautions* before premised are here made applicable to Practice; wherefore to this Treatise for the present I will put

An End.

Errata.

IN the Argument, Page 3.l.3. for *respect*,
read *desert*.

Pag. 3.l.17. for —65 sic 650 r. & sic &c.
p. 4 l. 15. for Figure 1. r. Figure 1. p. 6.l. 10.
for be r. &c. p. 7. l. 11. for 650 r. &c.

p. 11. lines $\left. \begin{array}{l} 10 \\ 11 \\ 12 \end{array} \right\}$ read $\left\{ \begin{array}{l} 2 \text{ Inches } \frac{2}{10} \\ \frac{1}{4} \text{ of an Inch.} \\ \frac{1}{12} \text{ of an Inch.} \end{array} \right.$

p. 13.l. 13. dele *for*, p. 15. l. 15. for Figure r.
Square, Cube, p. 17: l. ult. for Figure r. Fi-
gures, p 22.l. 4. r. and so on to, p. 26. l. 12.
for and r. are, p. 33. l. 7. for in r. as, p. 43.
l. 21. for 13984, r. 31464.



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